PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

Final Report
Investigation Results For
Normandale Community College

Date: 5/9/2012

Minnesota
STATE COLLEGES
& UNIVERSITIES

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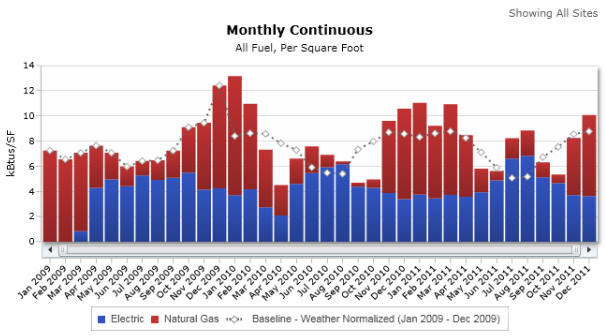
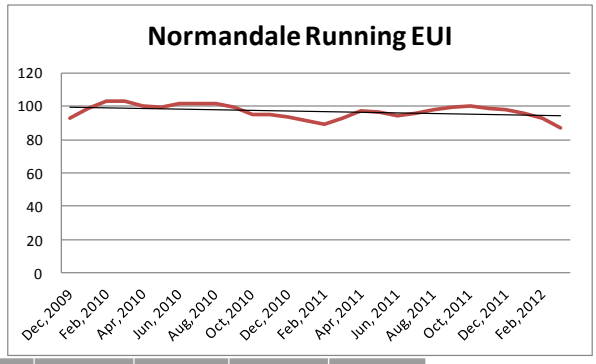
Normandale Community College Energy Investigation Overview

The goal of a PBEEEP Energy Investigation is to identify energy savings opportunities with a payback of fifteen years or less. Particular emphasis is on finding those opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. During the investigation phase the provider conducts a rigorous analysis of the building operations. Through observation, targeted functional testing, and analysis of extensive trend and portable logger data, the RCx Provider identifies deficiencies in the operation of the mechanical equipment, lighting, envelope, and related controls. The investigation of Normandale Community College was performed by Karges Faulconbridge, Inc. This report is the result of that information.

Payback Information and Energy Savings				
Total project costs (Without Co-funding)			**Project costs with Co-funding**	
Total costs to date including study	$86,347		Total Project Cost	$121,707
Future costs including Implementation , Measurement & Verification	$36,720		Study and Administrative Cost Paid with ARRA Funds	($86,347)
Total Project Cost	$121,707		Utility Co-funding	($0)
			Total costs after co-funding	$35,360
Estimated Annual Total Savings ($)	$26,291		Estimated Annual Total Savings ($)	$26,291
Total Project Payback	4.6		Total Project Payback with co-funding	1.3
Electric Energy Savings (235,988 of 7,510,531 kWh)	**3.1%**	**and**	**Natural Gas Savings (19,215 of 210,728 Therms (2010))**	**9.1%**





Year	Days	SF	Total kBtu	Normalized Baseline kBtu	Change from Baseline kBtu	% Change	Total Energy Cost $	Average Cost Rate $ /kBtu
2009	365	476,110	44,105,104	44,105,104	0	0%	$624,513.54	$0.01
2010	365	476,110	44,391,862	42,901,556	1,490,306	3%	$714,238.00	$0.02
2011	365	476,110	46,698,687	42,278,246	4,420,441	10%	$779,374.72	$0.02

Normandale Community College Consumption Report
Total energy use decreased 2% during the period of the investigation

Summary Tables

Normandale Community College	
Location	9700 France Avenue, Bloomington, MN
Facility Manager	Cris Broin
Project Manager	Ed Wines, VP Finance and Operations
Owner's Representative	John Williamson, Willen, Inc.
Interior Square Footage	492,731
PBEEEP Provider	Karges, Faulconbridge, Inc.
Annual Energy Cost	$ 593,842 (2011) Source: B3
Utility Company	Electric: Xcel Energy Natural Gas: Center Point Energy
Site Energy Use Index (EUI)	98 kBtu/ft^2 (at start of study) 96 kBtu/ft^2 (at end of study)
Benchmark EUI (from B3)	154 kBtu/ft^2

Building Name	State ID	Area (Square Feet)	Year Built
Activities Bldg Addition	E26156C0979	17,990	1979
Activities Building	E26156C0267	27,367	1967
Institutional Services	E26156C1295	7,574	1995
College Services Bldg PH 6A	E26156C1090	36,626	1990
College Services Bldg PH 6B	E26156C0996	70,073	1996
Commons Bldg	E26156C0468	44,482	1968
Fine Arts Bldg	E26156C0572	58,553	1972
Fine Arts Patio Infill	E26156C1193	2,038	1993
Fine Arts Addition	E26156C07	16,621	2007
Library Addition	E26156C0879	30,635	1979
Library Building	E26156C0167	34,968	1967
East Science Building	E26156C0368	26,401	1968
Science Bldg Addition	E26156C1303	43,945	2003
West Science Bldg	E26156C0775	34,853	1975

Mechanical Equipment Summary Table (of buildings included in the investigation)	
Quantity	**Equipment Description**
1	Automation System
29	Air Handlers
248	VAV Boxes
2	Rooftop Units
1	Make-up Air Units
1	Steam Boilers

14	Hot Water Boilers
4	Chillers
15	Hot or Chilled Water Pumps
6	Energy Recovery Units or Heat Reclaim Units

Implementation Information			
Estimated Annual Total Savings ($)			$26,291
Total Estimated Implementation Cost ($)			$32,360
GHG Avoided in U.S Tons (CO2e)			309
Electric Energy Savings (kWh) 1.4 % Savings 2010 Electric Usage 2,442,545 kWh (from B3)			235,988
Electric Demand Savings (Peak kW) 0 % Savings			22
Natural Gas Savings 14.1% Savings 2010 Natural Gas Usage 137,802Thermsfrom B3			19,215
Statistics			
Number of Measures identified			9
Number of Measures with payback < 3 years			5
Screening Start Date	6/25/2010	Screening End Date	9/23/2010
Investigation Start Date	1/12/2011	Investigation End Date	4/26/2012
Final Report	5/9/2012		

Normandale Community College Cost Information			
Phase		**To date**	**Estimated**
Screening		$7,226	
Investigation [Provider]		$72,700	
Investigation [CEE]		$6,241	$1,000
Implementation			$32,360
Implementation [CEE]			$1,000
Measurement & Verification		0	$1,000
Total		$86,347	$35,360

Co-funding Summary	
Study and Administrative Cost	$86,347
Utility Co-Funding - Estimated Total ($)	$0
Building Automation System Upgrade	$86,347
Total Co-funding ($)	$53,277

Facility Overview

The energy investigation identified 5.8% of total energy savings at Normandale Community College with measures that payback in less than 15 years and do not adversely affect occupant comfort. The energy savings opportunities identified at Normandale Community College are based on more closely scheduling equipment to match building occupancy; replacing a missing belt on a heat recovery unit; repairing or replacing faulty sensors; reducing minimum ventilations levels in some areas; using day lighting controls and replacing 32 Watt lamps with 28W lamps as the old ones burn out. The total cost of implementing all the measures is $32,360.

Implementing all these measures can save the college approximately $26,291 a year with a combined payback period of 1.1 years before rebates based on the implementation cost only (excluding study and administrative costs). These measures will produce 3.1% electrical savings and 9.1% natural gas savings. The building is currently performing at 38% below the Minnesota Benchmarking and Beyond database (B3) benchmark.

The primary energy intensive systems at Normandale Community College are described here:

The Normandale Community College campus consists of 19 buildings of varying size and configurations, totaling 492,731 interior square feet. The buildings are arranged as a doughnut with a courtyard in the middle. Of the 19 buildings, 15 are recommended for investigation, totaling 452,126 interior square feet. The five buildings not recommended are the Kopp Student Center because of a full HVAC remodel is under way currently, Garage North Lot, Pole Barn North, Bio Green House, and Garage West Lot because they are very small and don't have any mechanical equipment.

Mechanical Equipment

Main Building

Mechanical Equipment

The entire campus is heated with hot water from fourteen boilers and cooled by chilled water from four chillers. Most of the air handlers are variable air volume with reheats in the terminal boxes, although there are some constant volume systems also. There are six units with heat recovery or energy recovery.

The campus hot water system is a decentralized system consisting of interconnected natural gas boilers. The primary hot water sources are the 4 condensing boilers in the College Services Building 6b, 6 condensing boilers in the Fine Arts building, 2 condensing boilers in the east Science building and 2 fire tube boilers in the Jodsaas science building. The hot water circulation is primary secondary pumping systems.

There are several boilers being replaced during the fall to try to centralize the heating plant. The electric boilers in the Library are being removed permanently. The two boilers in the College Services are being replaced with four smaller high-efficiency units. Currently there are two heating loops, the north and south loop. The north loop covers the Science building, Activities Building, and the Kopp Student Center, the south loop covers the Fine Arts, College Services, and Library. The work to combine the two loops will be completed this year.

The campus chilled water system is a decentralized system of consisting of four air cooled chillers that are currently partially interconnected to provide chilled water throughout the campus. A project is being designed for 2011 completion to complete the interconnection of the chillers.

Controls and Trending

Normandale Community College has a UHL Building Automation System (BAS) capable of trending. The trend data can be exported to CSV files one by one. The system has full DDC controls and is very comprehensive; it covers some equipment all the way down to the zone level, but not in all areas. The system is web based and remote access is possible. Several pieces of equipment are still pneumatically actuated with DDC control.

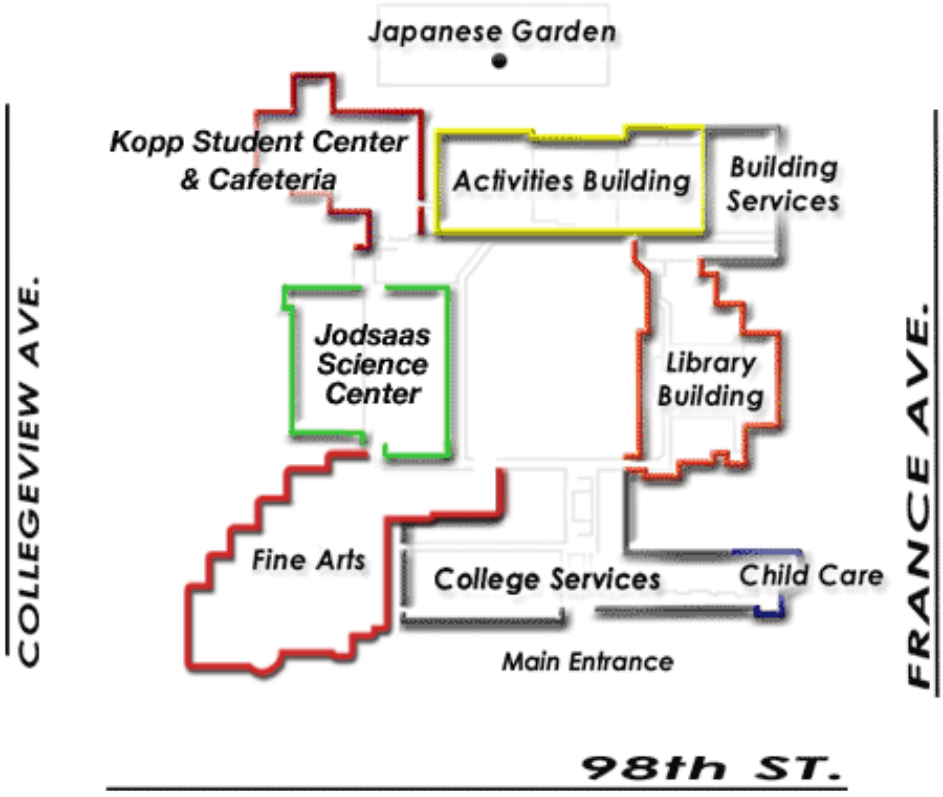
Lighting

Almost all of the lighting is done with 32W T8s with some canned lighting with CFLs. There is some special lighting for the large auditorium and the large theatre. The main lighting in the Fine Arts Building, and Activities Building, is controlled by the BAS system, while the rest is controlled by light switches.

Metering

The campus has five natural gas meters and one electrical meter. They also have fuel oil as a back-up source for the steam boilers. Each of the six transformers are sub-metered and data export and remote access to monitoring software is possible. An inventory for each transformer of equipment attached to it is available.

Map of the Campus



Findings Summary

Building: Normandale College Main Buidlings

Site: Normandale CC

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
7	Finding #7 - AHU Scheduling	$1,300	$18,024	0.07	$0	0.07	194
3	Finding #3: Heat Wheel Belt is broken. Motor spins but wheel does not.	$500	$1,099	0.45	$0	0.45	8
10	Finding #10 - Bad CO2 Sensor on AHU G Activities	$700	$585	1.20	$0	1.20	4
8	Finding #8 - Reduce Gym Ventilation	$1,100	$572	1.92	$0	1.92	5
5	Finding #5: AHU-B minimum ventilation rate is set higher than required for space square footage.	$1,100	$538	2.05	$0	2.05	4
1	Finding #1: Add daylighting control to areas of the buildings that are conducive.	$3,200	$836	3.83	$200	3.59	10
6	Finding #6: AHU-D minimum ventilation rate is set higher than required for space square footage.	$1,100	$303	3.63	$0	3.63	3
4	Finding #4: Vending machine occupancy sensors.	$2,160	$563	3.84	$0	3.84	12
2	Finding #2: Reduce lighting power by retrofitting lamps.	$21,200	$3,771	5.62	$2,120	5.06	69
	Total for Findings with Payback 3 years or less:	**$4,700**	**$20,818**	**0.23**	**$0**	**0.23**	**215**
	Total for all Findings:	**$32,360**	**$26,291**	**1.23**	**$2,320**	**1.14**	**309**

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

12900 Normandale

Finding Type Number	Finding Type	Relevant Findings (if any)	Finding Location	Reason for no relevant finding
a.1 (1)	Time of Day enabling is excessive	1		
a.2 (2)	Equipment is enabled regardless of need, or such enabling is excessive	1		
a.3 (3)	Lighting is on more hours than necessary.	1		
a.4 (4)	OTHER_Equipment Scheduling/Enabling			1
b.1 (5)	Economizer Operation – Inadequate Free Cooling (Damper failed in minimum or closed position,			1
b.2 (6)	Over-Ventilation – Outside air damper failed in an open position. Minimum outside air fraction not set	1		
b.3 (7)	OTHER_Economizer/OA Loads		1	
c.1 (8)	Simultaneous Heating and Cooling is present and excessive		1	
c.2 (9)	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement	1		
c.3 (10)	Controls "hunt" and/or need Loop Tuning or separation of heating/cooling setpoints	1		
c.4 (11)	OTHER_Controls			1
d.1 (12)	Daylighting controls or occupancy sensors need optimization.	1		
d.2 (13)	Zone setpoint setup/setback are not implemented or are sub-optimal.	1		
d.3 (14)	Fan Speed Doesn't Vary Sufficiently		1	
d.4 (15)	Pump Speed Doesn't Vary Sufficiently			1
d.5 (16)	VAV Box Minimum Flow Setpoint is higher than necessary			1
d.6 (17)	Other_Controls (Setpoint Changes)			1
e.1 (18)	HW Supply Temperature Reset is not implemented or is sub-optimal		1	
e.2 (19)	CHW Supply Temperature Reset is not implemented or is sub-optimal		1	

e.3 (20)	Supply Air Temperature Reset is not implemented or is sub-optimal		1	
e.4 ( )	Supply Duct Static Pressure Reset is not implemented or is sub-optimal		1	
e.5 (21)	Condenser Water Temperature Reset is not implemented or is sub-optimal			
e.6 (22)	Other_Controls (Reset Schedules)			
f.1 (23)	Daylighting Control needs optimization—Spaces are Over-Lit	1		
f.2 (24)	Pump Discharge Throttled			1
f.3 (25)	Over-Pumping			1
f.4 (26)	Equipment is oversized for load.		1	
f.5 (27)	OTHER_Equipment Efficiency/Load Reduction			
g.1 (28)	VFD Retrofit - Fans			1
g.2 (29)	VFD Retrofit - Pumps			1
g.3 (30)	VFD Retrofit - Motors (process)			1
g.4 (31)	OTHER_VFD			1
h.1 (32)	Retrofit - Motors	Maybe		
h.2 (33)	Retrofit - Chillers			1
h.3 (34)	Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)	1		
h.4 (35)	Retrofit - Boilers			1
h.5 (36)	Retrofit - Packaged Gas fired heating			1
h.6 (37)	Retrofit - Heat Pumps			1
h.7 (38)	Retrofit - Equipment (custom)			1
h.8 (39)	Retrofit - Pumping distribution method			1
h.9 (40)	Retrofit - Energy/Heat Recovery	1		
h.10 (41)	Retrofit - System (custom)			
h.11 (42)	Retrofit - Efficient Lighting	1		

h.12 (43)	Retrofit - Building Envelope			1
h.13 (44)	Retrofit - Alternative Energy			1
h.14 (45)	OTHER_Retrofit			1
i.1 (46)	Differed Maintenance from Recommended/Standard	1		
i.2 (47)	Impurity/Contamination			1
i.3 ( )	Leaky/Stuck Damper	1		
i.4 ( )	Leaky/Stuck Valve	1		
i.5 (48)	OTHER_Maintenance	1		
j.1 (49)	OTHER			

Findings Glossary: Findings Examples

a.1 (1)	**Time of Day enabling is excessive**
	• HVAC running when building is unoccupied. Equipment schedule doesn't follow building occupancy • Optimum start-stop is not implemented • Controls in hand
a.2 (2)	**Equipment is enabled regardless of need, or such enabling is excessive**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating
a.3 (3)	**Lighting is on more hours than necessary**
	• Lighting is on at night when the building is unoccupied • Photocells could be used to control exterior lighting • Lighting controls not calibrated/adjusted properly
a.4 (4)	**OTHER Equipment Scheduling and Enabling**
	• Please contact PBEEEP Project Engineer for approval
b.1 (5)	**Economizer Operation – Inadequate Free Cooling**
	• Economizer is locked out whenever mechanical cooling is enabled (non-integrated economizer) • Economizer linkage is broken • Economizer setpoints could be optimized • Plywood used as the outdoor air control • Damper failed in minimum or closed position
b.2 (6)	**Over-Ventilation**
	• Demand-based ventilation control has been disabled • Outside air damper failed in an open position • Minimum outside air fraction not set to design specifications or occupancy
b.3 (7)	**OTHER Economizer/Outside Air Loads**
	• Please contact PBEEEP Project Engineer for approval
c.1 (8)	**Simultaneous Heating and Cooling is present and excessive**
	• For a given zone, CHW and HW systems are unnecessarily on and running simultaneously • Different setpoints are used for two systems serving a common zone
c.2 (9)	**Sensor / Thermostat needs calibration, relocation / shielding, and/or replacement**
	• OAT temperature is reading 5 degrees high, resulting in loss of useful economizer operation • Zone sensors need to be relocated after tenant improvements • OAT sensor reads high in sunlight
c.3 (10)	**Controls "hunt" / need Loop Tuning or separation of heating/cooling setpoints**
	• CHW valve cycles open and closed • System needs loop tuning – it is cycling between heating and cooling
c.4 (11)	**OTHER Controls**
	• Please contact PBEEEP Project Engineer for approval
d.1 (12)	**Daylighting controls or occupancy sensors need optimization**
	• Existing controls are not functioning or overridden • Light sensors improperly placed or out of calibration
d.2 (13)	**Zone setpoint setup / setback are not implemented or are sub-optimal**
	• The cooling setpoint is 74 ºF 24 hours per day
d.3 (14)	**Fan Speed Doesn't Vary Sufficiently**
	• Fan runs at 2" static pressure. Lowering pressure to 1.8" does not create comfort problem and the flow is per design. • Supply air temperature and pressure reset: cooling and heating

d.4 (15)	**Pump Speed Doesn't Vary Sufficiently**
	• Pump runs at 15 PSI on peak day. Lowering pressure to 12 does not create comfort problem and the flow is per design. Low ΔT across the chiller during low load conditions.
d.5 (16)	**VAV Box Minimum Flow Setpoint is higher than necessary**
	• Boxes universally set at 40%, regardless of occupancy. Most boxes can have setpoints lowered and still meet minimum airflow requirements.
d.6 (17)	**Other Controls (Setpoint Changes)**
	• Please contact PBEEEP Project Engineer for approval
e.1 (18)	**HW Supply Temperature Reset is not implemented or is sub-optimal**
	• HW supply temperature is a constant 180 ºF. It should be reset based on demand, or decreased by a reset schedule as OAT increases. • DHW Setpoints are constant 24 hours per day
e.2 (19)	**CHW Supply Temperature Reset is not implemented or is sub-optimal**
	• CHW supply temperature is a constant 42 ºF. It could be reset, based on demand or ambient temperature.
e.3 (20)	**Supply Air Temperature Reset is not implemented or is sub-optimal**
	• The SAT is constant at 55 ºF. It could be reset to minimize reheat and maximize economizer cooling. The reset should ideally be based on demand (e.g., looking at zone box damper positions), but could also be reset based on OAT.
e.4 ( )	**Supply Duct Static Pressure Reset is not implemented or is suboptimal**
	• The Duct Static Pressure (DSP) is constant at 1.5" wc. It could be reset to minimize fan energy. The reset should ideally be based on demand (e.g. looking at zone box damper positions), but could also be reset based on OAT.
e.5 (21)	**Condenser Water Temperature Reset is not implemented or is sub-optimal**
	• CW temperature is constant leaving the tower at 85 ºF. The temperature should be reduced to minimize the total energy use of the chiller and tower. It may be worthwhile to reset based on load and ambient conditions.
e.6 (22)	**Other Controls (Reset Schedules)**
	• Please contact PBEEEP Project Engineer for approval
f.1 (23)	**Lighting system needs optimization - Spaces are overlit**
	• Lighting exceeds ASHRAE or IES standard levels for specific space types or tasks
f.2 (24)	**Pump Discharge Throttled**
	• The discharge valve for the CHW pump is 30% open. The valve should be opened and the impeller size reduced to provide the proper flow without throttling.
f.3 (25)	**Over-Pumping**
	• Only one CHW pump runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
f.4 (26)	**Equipment is oversized for load**
	• The equipment cycles unnecessarily • The peak load is much less than the installed equipment capacity

f.5 (27)	**OTHER Equipment Efficiency/Load Reduction**
	• Please contact PBEEEP Project Engineer for approval
g.1 (28)	**VFD Retrofit Fans**
	• Fan serves variable flow system, but does not have a VFD. • VFD is in override mode, and was found to be not modulating.
g.2 (29)	**VFD Retrofit - Pumps**
	• 3-way valves are used to maintain constant flow during low load periods. • Only one CHW pumps runs when one chiller is running. However, due to the reduced pressure drop in the common piping, the pump is providing much greater flow than needed.
g.3 (30)	**VFD Retrofit - Motors (process)**
	• Motor is constant speed and uses a variable pitch sheave to obtain speed control.
g.4 (31)	**OTHER VFD**
	• Please contact PBEEEP Project Engineer for approval
h.1 (32)	**Retrofit - Motors**
	• Efficiency of installed motor is much lower than efficiency of currently available motors
h.2 (33)	**Retrofit - Chillers**
	• Efficiency of installed chiller is much lower than efficiency of currently available chillers
h.3 (34)	**Retrofit - Air Conditioners (Air Handling Units, Packaged Unitary Equipment)**
	• Efficiency of installed air conditioner is much lower than efficiency of currently available air conditioners
h.4 (35)	**Retrofit - Boilers**
	• Efficiency of installed boiler is much lower than efficiency of currently available boilers
h.5 (36)	**Retrofit - Packaged Gas-fired heating**
	• Efficiency of installed heaters is much lower than efficiency of currently available heaters
h.6 (37)	**Retrofit - Heat Pumps**
	• Efficiency of installed heat pump is much lower than efficiency of currently available heat pumps
h.7 (38)	**Retrofit - Equipment (custom)**
	• Efficiency of installed equipment is much lower than efficiency of currently available equipment
h.8 (39)	**Retrofit - Pumping distribution method**
	• Current pumping distribution system is inefficient, and could be optimized. • Pump distribution loop can be converted from primary to primary-secondary)
h.9 (40)	**Retrofit - Energy / Heat Recovery**
	• Energy is not recouped from the exhaust air. • Identification of equipment with higher effectiveness than the current equipment.
h.10 (41)	**Retrofit - System (custom)**
	• Efficiency of installed system is much lower than efficiency of another type of system
h.11 (42)	**Retrofit - Efficient lighting**
	• Efficiency of installed lamps, ballasts or fixtures are much lower than efficiency of currently available lamps, ballasts or fixtures.

h.12 (43)	**Retrofit - Building Envelope**
	• Insulation is missing or insufficient • Window glazing is inadequate • Too much air leakage into / out of the building • Mechanical systems operate during unoccupied periods in extreme weather
h.13 (44)	**Retrofit - Alternative Energy**
	• Alternative energy strategies, such as passive/active solar, wind, ground sheltered construction or other alternative, can be incorporated into the building design
h.14 (45)	**OTHER Retrofit**
	• Please contact PBEEEP Project Engineer for approval
i.1 (46)	**Differed Maintenance from Recommended/Standard**
	• Differed maintenance that results in sub-optimal energy performance. • Examples: Scale buildup on heat exchanger, broken linkages to control actuator missing equipment components, etc.
i.2 (47)	**Impurity/Contamination**
	• Impurities or contamination of operating fluids that result in sub-optimal performance. Examples include lack of chemical treatment to hot/cold water systems that result in elevated levels of TDS which affect energy efficiency.
i.3 ( )	**Leaky/Stuck Damper**
	• The outside or return air damper on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.4 ( )	**Leaky/Stuck Valve**
	• The heating or cooling coil valve on an AHU is leaking or is not modulating causing the energy use go up because of additional load to the central heating and/or cooling plant.
i.5 (48)	**OTHER Maintenance**
	• Please contact PBEEEP Project Engineer for approval
j.1 (49)	**OTHER**
	• Please contact PBEEEP Project Engineer for approval

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	1
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #1: Add daylighting control to areas of the buildings that are conducive.	Date Identified:	5/1/2011
Description of Finding:	Add Photo Cells to areas that have opportunity for daylighting control. Specific areas include: Fine Arts Entry, College Services South Corridor (2) locations, College Services 3rd Floor South, Library (3) locations.		
Equipment or System(s):	Interior Lighting	Finding Category:	Controls (Setpoint Changes)
Finding Type:	Daylighting controls or occupancy sensors need optimization		

Implementer:	Contractor or In house if they are capable	Benefits:	Reduce run time on lights in areas with daylighitng opportunitiy
Baseline Documentation Method:	Hours of Daylight per month used to calculate available daylight per day. Estimated 25% of that time would be cloud covered and photo cells would require lighting.		
Measure:	Add Photo Cells at locations where daylighting is applicable		
Recommendation for Implementation:	Install photocell at locations listed previously in this workbook.		
Evidence of Implementation Method:	Functionally test sensors to verify operation and adjust sensitivity as necessary. Provide paid invoices, work orders etc. as evidence that the work has been completed.		

Annual Electric Savings (kWh):	12,183	Contractor Cost ($):	$3,200
Estimated Annual kWh Savings ($):	$836	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$3,200

Estimated Annual Total Savings ($):	$836	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.83	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.59	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	10	Utility Co-Funding - Estimated Total ($):	$200

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	3.2%	Percent of Implementation Costs:	9.9%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	2
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #2: Reduce lighting power by retrofitting lamps.	Date Identified:	5/1/2011
Description of Finding:	Reduce Corridor Lamp Wattage in Corridors for all areas of the campus. The current 4 foot fluorescent lamps are 32 W. These lamps could be reduced to 28 W without expected loss in light quality in space. Only selected corridors because rooms were observed to have occupancy control. In reality, the entire campus should be dropped to 28 W or less. It is difficult to accurately assess the savings for areas with occupancy control. However, the campus should be able to install the 28W lamps across the board as they fail and they will see electrical savings. We cannot determine exactly how much, but logically, there will be savings with no cost if the lamps are replaced with lower wattages as they burn out. Areas include the main computer lab on the south of the building, all corridor lighting, and the library.		
Equipment or System(s):	Interior Lighting	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	In House Staff or contractorts	Benefits:	Reduced Wattage during run time of 4 W per lamp.
Baseline Documentation Method:	Provide invoices for the lamps. Provide completed work orders or paid invoices for the work if outside contractors have been hired for the installation. Spot check areas to ensure the lamps have been installed.		
Measure:	Replace 4 foot, 32 W lamps in corridors with 28 W lamps. Note: replace class room lamps with 28 W as they burn out (replace entire fixture with 28 W lamps, not piecemeal).		
Recommendation for Implementation:	Install 28 W lamps in corridors and other common areas immediately. Reserve the 32 W lamps and replace in classrooms and other areas of the building. As the 32 W lamps begin to burn out in class rooms and other office areas, replace them with 28 W lamps. Note: replace each lamp in the fixture with 28 W lamps when one lamp is replaced. Consider also adjusting the lighting schedule to reduce total hours to a lower amount.		
Evidence of Implementation Method:	Check to see that new lamps are installed.		

Annual Electric Savings (kWh):	80,190	Peak Demand Savings (kWh):	22
Estimated Annual kWh Savings ($):	$3,771	Estimated Annual Demand Savings ($):	$0
Contractor Cost ($):	$21,200		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$21,200		

Estimated Annual Total Savings ($):	$3,771	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	5.62	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	5.06	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	69	Utility Co-Funding - Estimated Total ($):	$2,120

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	14.3%	Percent of Implementation Costs:	65.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	3
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #3: Heat Wheel Belt is broken. Motor spins but wheel does not.	Date Identified:	3/1/2011
Description of Finding:	Replace Belt on Heat Wheel that is broken. Heat wheel is non functional.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Maintenance Related Problems
Finding Type:	Other Maintenance		

Implementer:	In House Staff	Benefits:	Allows heat recover equipment to operate
Baseline Documentation Method:	Visually inspected equipment and found belt broken.		
Measure:	Replace heat wheel belt so that the wheel rotates.		
Recommendation for Implementation:	Replace the Belt on the Heat Wheel.		
Evidence of Implementation Method:	Confirm belt is installed. Similar equipment appears to operate correctly. Wheel command is on but belt is broken. Provide work orders, pictures, etc. to confirm that work has been completed.		

Annual Electric Savings (kWh):	190	Annual Natural Gas Savings (therms):	1,334
Estimated Annual kWh Savings ($):	$8	Estimated Annual Natural Gas Savings ($):	$1,091
Contractor Cost ($):	$500		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$500		

Estimated Annual Total Savings ($):	$1,099	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.45	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.45	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	8	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	4.2%	Percent of Implementation Costs:	1.5%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	4
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #4: Vending machine occupancy sensors.	Date Identified:	5/1/2011
Description of Finding:	Install Occ Sensors on Vending Machines. There are 12 pop machines in the building that are not currently controlled for occupancy. The units run at ful power at all times of the day. Vending mizers can be installed to turn the units down during unnoccupied periods of time.		
Equipment or System(s):	Other	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Vendor	Benefits:	Allows vending machines to power down when areas are unoccupied.
Baseline Documentation Method:	There are no occupancy sensors on the pop machines currently. Pop machines run at full power 24 hours per day.		
Measure:	Install Occ Sensors on Vending Machines		
Recommendation for Implementation:	Install on 12 vending machines (number found on campus)		
Evidence of Implementation Method:	Provide reciepts for equipment and work orders showing equipment was installed.		

Annual Electric Savings (kWh):	13,558	Contractor Cost ($):	$2,160
Estimated Annual kWh Savings ($):	$563	PBEEEP Provider Cost for Implementation Assistance ($):	$0
		Total Estimated Implementation Cost ($):	$2,160

Estimated Annual Total Savings ($):	$563	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.84	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.84	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	12	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.1%	Percent of Implementation Costs:	6.7%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	5
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #5: AHU-B minimum ventilation rate is set higher than required for space square footage.	Date Identified:	5/1/2011
Description of Finding:	Reduce Ventilation at the Theatre. AHU B. Minimum ventilation air is set too high.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Controls contractor	Benefits:	Reduced Venitaltion on part and no load conditions.
Baseline Documentation Method:	Trending and screen captures show set points are not as low as they could be based on ASHRAE minimums for CO2 control. Quick check of ASHRAE minimum shows a lower CFM is possible.		
Measure:	Minimum OA set points should be set down to 390 cfm for AHU B from 1000. Screen captures of set points.		
Recommendation for Implementation:	Set the minimum OA down to 390 cfm from 1000 and 800 for AHU B and D respectively. This can be done easily on the BAS.		
Evidence of Implementation Method:	Trend log minimum OA CFM's versus CO2 levels to show reduced ventilation rates. Provide screen captures to demonstrate set points have been changed.		

Annual Electric Savings (kWh):	1,220	Annual Natural Gas Savings (therms):	595
Estimated Annual kWh Savings ($):	$51	Estimated Annual Natural Gas Savings ($):	$487
Contractor Cost ($):	$100		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,000		
Total Estimated Implementation Cost ($):	$1,100		

Estimated Annual Total Savings ($):	$538	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	2.05	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	2.05	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.0%	Percent of Implementation Costs:	3.4%

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	6
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #6: AHU-D minimum ventilation rate is set higher than required for space square footage.	Date Identified:	5/1/2011
Description of Finding:	Reduce Ventilation at the Auditorium. AHU D.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Controls contractor	Benefits:	Reduced Venitaltion on part and no load conditions.
Baseline Documentation Method:	Trending and screen captures show set points are not as low as they could be based on ASHRAE minimums for CO2 control. Quick check of ASHRAE minimum shows a lower CFM is possible.		
Measure:	Minimum OA set points should be set down to 390 cfm for AHU B from 1000. Screen captures of set points.		
Recommendation for Implementation:	Set the minimum OA down to 390 cfm from 800 for AHU D. This can be done easily on the BAS.		
Evidence of Implementation Method:	Trend log minimum OA CFM's versus CO2 levels to show reduced ventilation rates. Provide screen captures to demonstrate set points have been changed.		

Annual Electric Savings (kWh):	972	Annual Natural Gas Savings (therms):	321
Estimated Annual kWh Savings ($):	$40	Estimated Annual Natural Gas Savings ($):	$263
Contractor Cost ($):	$100		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,000		
Total Estimated Implementation Cost ($):	$1,100		

Estimated Annual Total Savings ($):	$303	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	3.63	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	3.63	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	3	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	1.2%	Percent of Implementation Costs:	3.4%

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	7
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #7 - AHU Scheduling	Date Identified:	11/30/2011
Description of Finding:	Reduce Unit Run times for the Following AHU's: Activities (AHU-K, G, H,), Fine Arts (AHU-A, B, C, D, E, F), AHU-10, AHU-11, AHU-1 6b, Science (AHU-1)		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Equipment Scheduling and Enabling
Finding Type:	Time of Day enabling is excessive		

Implementer:	In House Staff	Benefits:	Reduce run time for units. Reduces electrical fan power and ventilation loads.
Baseline Documentation Method:	Review schedules match actual building occupied times. Schedules are all over the board for different units. We used the provided building schedule as provided by the head of the facilities for the calculations. It is suggested to evaluate the actual schedule versus the building type. There are areas of the campus that are not likely occupied after 5 or 6 pm. Identify these areas and adjust the schedules even tighter for greater energy savings. This is the single largest issue on the campus.		
Measure:	Adjust schedules to match the actual occupied schedules.		
Recommendation for Implementation:	Correct the schedule to match the actual occupancy times. If there are reasons such as the building does not catch up in the mornings, then adjust the night set backs to higher/lower temperatures. It is not beneficial to operate the building in occupied mode when not required.		
Evidence of Implementation Method:	Provide screen captures and trending as possible to show the schedules have been adjusted to the actual building occupied times.		

Annual Electric Savings (kWh):	125,429	Annual Natural Gas Savings (therms):	15,665
Estimated Annual kWh Savings ($):	$5,206	Estimated Annual Natural Gas Savings ($):	$12,819
Contractor Cost ($):	$1,300		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$1,300		

Estimated Annual Total Savings ($):	$18,024	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.07	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.07	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	194	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	68.6%	Percent of Implementation Costs:	4.0%

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	8
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #8 - Reduce Gym Ventilation	Date Identified:	11/30/2011
Description of Finding:	Reduce Venitlation at the Gymnasium AHU-K. Minimum ventilation air set point is too high.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	OTHER
Finding Type:	Other		

Implementer:	Controls Contractor	Benefits:	Reduced ventilation equals reduced energy usage
Baseline Documentation Method:	Trending and screen captures show set points are not as low as they could be based on ASHRAE minimums for CO2 control. Quick check of ASHRAE minimum shows a lower CFM is possible.		
Measure:	change minimum OA setpoint at AHUk from 3000 to 975.		
Recommendation for Implementation:	Set new OA minimum from 3000 down to 975 for AHU-k. Let CO2 control the space set points up to a concentration of 1100 ppm until the max OA has been reached.		
Evidence of Implementation Method:	Trend log minimum OA CFM's versus CO2 levels to show reduced ventilation rates. Provide screen captures to demonstrate set points have been changed.		

Annual Electric Savings (kWh):	1,773	Annual Natural Gas Savings (therms):	609
Estimated Annual kWh Savings ($):	$74	Estimated Annual Natural Gas Savings ($):	$499
Contractor Cost ($):	$100		
PBEEEP Provider Cost for Implementation Assistance ($):	$1,000		
Total Estimated Implementation Cost ($):	$1,100		

Estimated Annual Total Savings ($):	$572	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.92	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.92	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	5	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.2%	Percent of Implementation Costs:	3.4%

Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	10
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #10 - Bad CO2 Sensor on AHU G Activities	Date Identified:	1/11/2012
Description of Finding:	AHU G Activities: The CO2 sensor has failed at the 2000 ppm position. Unit is continually trying to bring in maximum OA and the OA damper is bouncing off the minimum Temperature.		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Controls Problems
Finding Type:	Sensor/Thermostat needs calibration, relocation/shielding, and/or replacement		

Implementer:	UHL	Benefits:	The unit currently tries to bring in as much OA as possible to lower the CO2 set point until the MAT bounces off the Low Limit. This causes the dampers to hunt wildly and the heating valve modulates accordingly. Savings are by bringing the unit back in line with the original design intent.
Baseline Documentation Method:	Try to first disrupt power to the CO2 sensor for 5 minutes then reconnect the power. This may reset the CO2 sensor. If not, then it may need either recalibration or replacement. We found this very late on a last look through. This sensor was not operating like this previously. Verified the CO2 position on three separate days at 5 different times during that span.		
Measure:	Try to reset the CO2 sensor by disrupting power first. If that has no effect, then recailbration or replacement is required.		
Recommendation for Implementation:	Have UHL investigate the CO2 sensor to see if it can be reset or recalibrated. Replace as necessary. Verify PID loops are slow enough to prevent damper and valve hunting. Also verify OA CO2 sensor calibration and location. Have seen OA CO2 concentrations at levels over 700 ppm. Sensor could be picking up CO2 due to the location if near car exhaust, etc.		
Evidence of Implementation Method:	Verify sensor has either been replaced or re-set. Provide paid invoice from UHL that shows sensor was addressed. Trend to make sure sensor is operating within expected parameters. Trend CO2, MAT, RAT, DAT, OA Damper, OA CFM, when below 30F OAT so see less cycling. Also look for OACFM to reset to maintain CO2 below set level.		

Annual Electric Savings (kWh):	473	Annual Natural Gas Savings (therms):	691
Estimated Annual kWh Savings ($):	$20	Estimated Annual Natural Gas Savings ($):	$565
Contractor Cost ($):	$700		
PBEEEP Provider Cost for Implementation Assistance ($):	$0		
Total Estimated Implementation Cost ($):	$700		

Estimated Annual Total Savings ($):	$585	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	1.20	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	1.20	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	4	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	2.2%	Percent of Implementation Costs:	2.2%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Details

Building: Normandale College Main Buidlings

FWB Number:	12900	Eco Number:	9
Site:	Normandale CC	Date/Time Created:	5/9/2012

Investigation Finding:	Finding #9 - Change RH setpoints	Date Identified:	11/30/2011
Description of Finding:	Lower Relative Humidity Set Points for AHU-3 from 35% to 25 % with an average room temperature of 72 degrees. Remove from findings		
Equipment or System(s):	AHU with heating and cooling	Finding Category:	Deleted
Finding Type:	Finding Deleted by Provider		

Implementer:	In House Staff	Benefits:	Reduced cost of humidification for this space and reduced maintenance of the humidifier.
Baseline Documentation Method:	Set the space relative humidity from 35% to 25%. Consider lowering the space temperature from 72 to 70 degrees to comply with state guidelines of 68 degrees during the heating for greater savings on humidification. This is just set points on the BAS.		
Measure:	The current space temperatures are 72 degrees and 35% RH. Set space temperatures at 70 maximum and 25% RH for savings on humidification.		
Recommendation for Implementation:	College to determine if 35% RH is really necessary for this area of the building. In most cases that are not archival or computer rooms, humidity of 35% is not absolutely necessary. Small changes in temperature and RH set points can make large differences in the amount of energy that is consumed.		
Evidence of Implementation Method:	Provide screen captures and trending as possible to show the setpoints have been adjusted to the actual building occupied times.It is estimated that when implemented this measure will save 2,892 therms of natural gas (after intereactiosn) and $2,366. There is little or no cost of implementation.		

Estimated Annual Total Savings ($):	$0	Utility Co-Funding for kWh ($):	$0
Initial Simple Payback (years):	0.00	Utility Co-Funding for kW ($):	$0
Simple Payback w/ Utility Co-Funding (years):	0.00	Utility Co-Funding for therms ($):	$0
GHG Avoided in U.S. Tons (C02e):	0	Utility Co-Funding - Estimated Total ($):	$0

Current Project as Percentage of Total project			
Percent Savings (Costs basis)	0.0%	Percent of Implementation Costs:	0.0%

PBEEEP was made possible with funding from the U.S. Department of Energy and the MN Department of Commerce.

Deleted Findings Summary

Building: Normandale College Main Buidlings

Site: Normandale CC

Eco #	Investigation Finding	Total Cost	Savings	Payback	Co-Funding	Payback Co-Funding	GHG
9	Finding #9 - Change RH setpoints	$0	$0	0.00	$0	0.00	0
	Total for Findings with Payback 3 years or less:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**
	Total for all Findings:	**$0**	**$0**	**0.00**	**$0**	**0.00**	**0**

PBEEEP
State Government

Public Buildings Enhanced Energy Efficiency Program

ATTACHMENT 4: SCREENING RESULTS FOR NORMANDALE COMMUNITY COLLEGE

October 21, 2010

Campus Summary Table

Normandale Community College	
Location	9700 France Avenue, Bloomington, MN
Facility Manager	Cris Broin
Number of Buildings	18
Interior Square Footage	492,731
PBEEEP Provider	Center for Energy and Environment
Date Visited	6/25/2010
State Project Manager	Ed Wines, VP Finance and Operations
Annual Energy Cost	$733,258 (2009)
Utility Company	Xcel Energy (electric) CenterPoint Energy (natural gas)
Site Energy Use Index (EUI)	119.3 kBtu/sq.ft. (2009)
Benchmark EUI (from B3)	151.6 kBtu/sq.ft. (2009)

Recommendation for Investigation:

The campus consists of 19 buildings of varying size and configurations, totaling 492,731 interior square feet. The buildings are arranged as a doughnut with a courtyard in the middle. Of the 19 buildings, 15 are recommended for investigation, totaling 452,126 interior square feet. The five buildings not recommended are the Kopp Student Center because of a full HVAC remodel is under way currently, Garage North Lot, Pole Barn North, Bio Green House, and Garage West Lot because they are very small and don't have any mechanical equipment.

There are many factors that are part of the decision to recommend an energy investigation of a building; at Normandale Community College the following characteristics were important in the building selection process:

- Large buildings
- Central Building Automation System with control down to zone level
- Large Air Handling Units
- Central Heating and Cooling Systems

Buildings Recommended for Investigation

Building Name	State ID	Building Group	Area (Square Feet)	Year Built
Activities Bldg Addition	E26156C0979	Activities	17,990	1979
Activities Building	E26156C0267	Activities	27,367	1967
Institutional Services	E26156C1295	Building Services	7,574	1995
College Services Bldg PH 6A	E26156C1090	College Services	36,626	1990
College Services Bldg PH 6B	E26156C0996	College Services	70,073	1996
Commons Bldg	E26156C0468	College Services	44,482	1968
Fine Arts Bldg	E26156C0572	Fine Arts	58,553	1972
Fine Arts Patio Infill	E26156C1193	Fine Arts	2,038	1993
Fine Arts Addition	E26156C07	Fine Arts	16,621	2007
Library Addition	E26156C0879	Library	30,635	1979
Library Building	E26156C0167	Library	34,968	1967
East Science Building	E26156C0368	Science	26,401	1968
Science Bldg Addition	E26156C1303	Science	43,945	2003
West Science Bldg	E26156C0775	Science	34,853	1975

Buildings Not Recommended for Investigation

Building Name	State ID	Area (Square Feet)	Year Built
Garage North Lot	E26156C0672	700	1972
Pole Barn North	E26156C0892	3,200	1992
Bio Green House	E26156C1104	1,221	2004
Garage West Lot	E26156C1068	1,750	1968
College Center Bldg	E26156C0675	33,734	1975

Normandale Community College Screening Overview

The goal of screening is to identify buildings where an in-depth energy investigation can be performed to identify energy saving opportunities that will generate savings with a relatively fast (1 to 5 years) and certain payback. The screening of Normandale Community College was performed by the Center for Energy and Environment (CEE) with the assistance of the facility staff. A walk-through was conducted on June 25, 2010 and interviews with the facility staff were carried out to fully explore the status of the energy consuming equipment and its potential for recommissioning. This report is the result of that information.

The following information was obtained during the screening process and pertains to only the buildings being recommended for investigation.

Mechanical Equipment

The entire campus is heated with hot water from fourteen boilers and cooled by chilled water from four chillers. Most of the air handlers are variable air volume with reheats in the terminal boxes, although there are some constant volume systems also. There are six units with heat recovery or energy recovery.

The campus hot water system is a decentralized system consisting of interconnected natural gas boilers. The primary hot water sources are the 4 condensing boilers in the College Services Building 6b, 6 condensing boilers in the Fine Arts building, 2 condensing boilers in the east Science building and 2 fire tube boilers in the Jodsaas science building. The hot water circulation is primary secondary pumping systems.

There are several boilers being replaced during the fall to try to centralize the heating plant. The electric boilers in the Library are being removed permanently. The two boilers in the College Services are being replaced with four smaller high-efficiency units. Currently there are two heating loops, the north and south loop. The north loop covers the Science building, Activities Building, and the Kopp Student Center, the south loop covers the Fine Arts, College Services, and Library. The work to combine the two loops will be completed this year.

The campus chilled water system is a decentralized system of consisting of four air cooled chillers that are currently partially interconnected to provide chilled water throughout the campus. A project is being designed for 2011 completion to complete the interconnection of the chillers.

The table below gives an overview of the types and quantities of equipment on the campus.

Mechanical Equipment Summary Table*	
1	Automation Systems
14	Buildings
452,126	Square Feet
29	Air Handlers
248	VAV Boxes
2	Rooftop Units
1	Make-up Air Units
1	Steam Boilers
14	Hot Water Boilers
4	Chillers
15	Hot or Chilled Water Pumps
6	Energy Recovery Units or Heat Reclaim Units

Controls and Trending

Normandale Community College has a UHL Building Automation System (BAS) capable of trending. The trend data can be exported to CSV files one by one. The system has full DDC controls and is very comprehensive; it covers some equipment all the way down to the zone level, but not in all areas. The system is web based and remote access is possible. Several pieces of equipment are still pneumatically actuated with DDC control.

Lighting

Almost all of the lighting is done with 32W T8s with some canned lighting with CFLs. There is some special lighting for the large auditorium and the large theatre. The main lighting in the Fine Arts Building, and Activities Building, is controlled by the BAS system, while the rest is controlled by light switches.

Energy Use Index B3 Benchmark

The Energy Use Index (EUI) is 123.5 kBtu/sqft, which is 19% lower than the B3 Benchmark of 151.6.

Metering

The campus has five natural gas meters and one electrical meter. They also have fuel oil as a back-up source for the steam boilers. Each of the six transformers are sub-metered and data export and remote access to monitoring software is possible. An inventory for each transformer of equipment attached to it is available.

Documentation

The level of documentation is very good at Normandale Community College. There are as-built plans for most recent projects. The mechanical equipment schedules are available for the most part. Manuals and project folders are plentiful.

Library Building Library Addition			State ID # E26156C0167 State ID # E26156C0879		
Area (sq.ft)	65,603	Year Built	1967/79	Occupancy (hrs/yr)	4,992

HVAC Equipment

- **6 AHUs**

AHU-10		SF 15hp, RF 3hp	Serves core of library on all floors. Controlled to 60/70/80%
AHU-11		SF 15hp, RF 3hp	Serves core of library on all floors. Controlled to 60/70/80%
AHU-12			Serves TV Studio
AHU-13		SF 3hp,	Multizone. Serves IT rooms
AHU-14		SF 7.5hp	Serves South end of library
AHU-15		SF 20hp, RF 10hp	Serves east addition. Replaced and Commissioned in 2010. Has 27 VAV Boxes.

- **27 VAV Boxes**
- **Heating/Cooling**

Trane Chiller		450 Tons	
CHWP		20hp, 882gpm	
HWP		1hp, 110gpm (2X)	Serves VAVs and AHUs
HWP (rad)		1hp, 45gpm	Serves radiation only

Points on BAS

- **VAV AHUs:** SF Status and speed, DSP and setpoint, SF-Flow, RF Status and Speed, Chilled Water Valve, Hot Water Valve, DAT and setpoint, MAT, RAT,RA-RH, RA-CO2 and setpoint, Return, Relief, and OA Damper position, Space Static Pressure and setpoint.
- **CV AHUs:** SF Status, RF Status, Chilled Water Valve, Hot Water Valve on some, DAT and setpoint, MAT, RAT, Return, Relief, and OA Damper position, Multizone unit has Dual Duct with DAT setpoints for each.
- **Floor Plans:** Space Temperatures from VAVs.
- **VAVs:** DAT, Min, Max, Setpoint, and Current Flow, Cooling Setpoint, Room Temperature, Damper Position.

Activities Building Activities Building Addition			State ID # E26156C0267 State ID # E26156C0979		
Area (sq.ft)	45,357	Year Built	1967/1979/2008	Occupancy (hrs/yr)	4,992

HVAC Equipment

- **4 AHUs**

AHU-J	SF 7.5hp 7,000cfm, RF 5hp 7,000cfm	Serves Locker rooms and fitness center. Has ERV coupled to it.
AHU-G	SF 7.5hp 6,000cfm, RF 3hp 6,000cfm	Serves Fitness Studio and labs. Face & By-Pass VAV.
AHU-H	SF 15hp 16,000cfm, RF 7.5hp 16,000cfm	Serves 2nd Floor. Face & By-Pass VAV. Has 31 VAVs.
AHU-K	SF 25hp 27,000cfm, RF 15hp 27,000cfm	Serves Gym. Face & By-Pass VAV.
ERV-J	2x 5hp 4,600cfm	Attached to AHU-J.

- **45 VAV Boxes**
- **Heating/Cooling**

CHWP	15hp	Has VFD, controlled to DP. 40% Glycol
HWP	20hp	Has VFD, controlled to DP.

Points on BAS

- **AHUs:** SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, By-Pass Damper Position, OA Damper Pos, Return Damper Pos, Relief Damper Pos, RF Status and Speed, DAT and setpoint, MAT, RAT, RA-RH, RA-CO2, OA Flow and setpoint, Filter DP, Space Static Pressure and setpoint, OA vs RA Enthalpy Diff setpoint.
- **ERU-J:** OA Fan Speed, RA Fan Speed, ERV OA Flow
- **Space:** Space Temperatures where VAVs are located.
- **VAVs:** DAT, Min, Max, Setpoint, and Current Flow, Cooling Setpoint, Room Temperature, Damper Position.
- **Hot Water:** Pump Status and Speed, HWST, HWRT, HW Flow, HW DP and setpoint.
- **Chilled Water:** Pump Status and Speed, CHWST, CHWRT, CHW Flow, CHW DP and setpoint.

Comments

This building has all new (2008) HVAC and was commissioned at that time.

Commons Building				State ID # E2615C0468	
Area (sq.ft)	44,482	Year Built	1968	Occupancy (hrs/yr)	4,992

HVAC Equipment

- **2 AHUs**

AHU-1	2005	SF 7.5hp, RF 4hp 20kW Electric Heat, 15.4 Tons Cooling	Exterior AAON unit. Has 20 VAV boxes 12.2 EER
AHU-2		SF 30hp, RF 15hp	The SF and RF have a common VFD used to slow things down, not controlled to anything.

- **20 VAV Boxes**

Points on BAS

- **AHU-1:** SF-S and Speed, RF-S, DX Stage 1 and 2, Heat Status, DAT and setpoint, DSP and setpoint, OA Damper and Mixing damper Position, RAT, Max and Min Space Temp
- **VAVs:** Damper Position, Flow: Current, Min, Max, and Setpoint, Reheat Valve Position, Space Temp and setpoint.
- **AHU-2:** SF Status and Current, RF Status and Current, Chilled Water Valve, DAT and setpoint, MAT, RAT, Return, Relief, and OA Damper position, VFD Speed

Comments

- For AHU-2 the SF VFD is set to a speed, not variable. The night operation is at 30%, morning is 70%. Day speed may change based on the day, hot day may require 70%, mild day 50%.

Institutional Services				State ID # E2615C1295	
Area (sq.ft)	7,574	Year Built	1995	Occupancy (hrs/yr)	4,992

HVAC Equipment

- **2 RTUs**

RTU-1	Natural Gas Heating. DX Cooling
RTU-2	Natural Gas Heating. DX Cooling

Points on BAS

- None

Fine Arts Building Fine Arts Patio Infill Fine Arts Addition			State ID # E2615C0572 State ID # E2615C1193 State ID # E2615C			
Area (sq.ft)	77,212	Year Built	1972	Occupancy (hrs/yr)	4,992	

HVAC Equipment

- **6 AHUs**

AHU-A	2007	SF 15hp 11,500cfm, RF 7.5hp 11,500cfm	Serves Classrooms and Offices. Has Air-to-Air HX. VAV. Cx in 2008.
AHU-B	2007	SF 10hp 9,000cfm, RF 5hp 9,000cfm	Serves Theater. Cx in 2008. Has Enthalpy Wheel. VAV
AHU-C	2007	SF 25hp 18,000cfm, RF 10hp 18,000cfm	Serves lobby and offices. VAV Cx in 2008.
AHU-D	2007	SF 20hp 8,000cfm, RF 7.5hp 8,000cfm	Serves Auditorium. Has Enthalpy Wheel. VAV
AHU-E	2007	SF 20hp 7,600cfm, RF 5hp 7,600cfm	Serves common areas. Has Enthalpy Wheel. VAV
AHU-F	2007	SF 7.5hp 4,100cfm, RF 3hp 4,100cfm	Serves ceramics area. Has Air-to-Air HX. VAV

- **31 VAV Boxes**
- **Heating/Cooling**

HWP-1&2	2007	5hp, 304gpm (2X)	Has VFD, Controlled to DP.
HWP-3&4	2007	5hp, 304gpm (2X)	Has VFD, Controlled to DP.
Booster HWP	2007	1.5hp, 86gpm (2X)	Has VFD, Controlled to DP.
Booster HWP	2007	0.75hp, 76gpm (4X)	
HWP	2007	0.25hp, 25gpm	Serves AHU-C
CHWP-1&2	2007	25hp, 545gpm (2X)	Has VFD, Controlled to DP. Pumps run together by design.
Trane Chiller	2007	475 Tons	
Boilers (6X)	2007	4x 1,000kBtu/h, 2x 340kBtu/h = 4,800kBtu/h	

Points on BAS

- **AHU w/ ERV:** SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, Mixing Damper Position, OA Damper Pos, Relief Damper Pos, RF Status and Speed, DAT and setpoint, MAT, RAT, RA-RH, RA-CO2, RA-Enth, OA Flow, Filter DP, Space Static Pressure and setpoint, OA vs RA Enthalpy Diff setpoint.
- **ERUs:** Fan Status (Relief, Exhaust, Supply), Damper Position (Relief, Exhaust, Outdoor)
- **AHU w/ Heat Wheel:** SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, Mixing Damper Position, OA Damper Pos, Relief Damper Pos, Relief Fan Status and Speed, DAT and setpoint, MAT, RAT, RA-RH, RA-CO2, RA-Enth, OAT, OA-RH, OA-Enth, OA-CO2, OA Flow, Filter DP, Space Static Pressure and setpoint
- **VAVs:** Flows Actual, Setpoint, Min, Max, Heat, Reheat Valve Position, Damper Position, Space Temp and Setpoint, Supply Temperature. Some have electric reheat coil. Some have radiation valve position.
- **Chiller:** Chiller Status, Stage Status, Chiller Amps, CHWST and Setpoint, CHWRT, CHWS Pressure, CHWR Pressure, DP Setpoint, Pump Status and Speed.
- **Boilers:** Boiler Status, HWST and setpoint, HWRT, HWS Pressure, HWR Pressure, DP Setpoint, Pump Status and Speed, System Enable Setpoint
- **Floor plans:** VAV locations and Space Temperatures

Science Building

East Science Building **State ID #** E26156C0368
West Science "Jodshaas" Building **State ID #** E2615C0775
Science Building Addition **State ID #** E2615C1303

Area (sq.ft)	105,199	Year Built	1968/75/2003	Occupancy	4,992

HVAC Equipment

- **7 AHUs**

AHU-1	SF 25hp 16,000cfm, RF 5hp 11,000cfm	Serves north wing of 2nd Floor. VAV
AHU-2	SF 30hp 24,000cfm, EF 15hp 17,500cfm	Serves Biology. Has Air-to-Air HX. Note Exhaust fan. VAV
AHU-3	SF 30hp 25,000cfm	Serves Chemistry rooms. 100% OA. VAV
AHU-4		Serves center classrooms on 1st floor.
AHU-5	RF 5hp	Serves east classrooms on 1st floor.
AHU-6	SF 5hp, RF 5hp	Serves east classrooms on 2nd floor
MAU-1	SF 3hp 4,500cfm	100% OA. Gas-fired

- **57 VAV Boxes**
- **Heating/Cooling**

Steam Boiler	1,500 kBtu/h	Used for humidification of the spaces.
Boilers (2X) (2X)	6,000kBtu/h 1,000kBtu/h	Hope to only use when needed after HW system project. North HW Loop. Commissioned in 2009.
York Chiller	375 Tons	Air cooled on roof.
Chiller 2	275 Tons	Air cooled on roof.
CHWP	25hp, 800gpm (1X)	For York Chiller
CHWP	15hp, 675gpm (3X)	
HWP	10hp, 225gpm (2X) 15hp, 275hpm (2X)	Commissioned in 2009.

- **Exhaust Fans**

Exhaust Fans (7X)	39,810cfm total exhaust	Most for Chemistry, one for Biology. Serves 20 fume hoods.

Points on BAS

- **AHU VAV**: SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, Min OA Damper Pos, Economizer Damper Pos, Relief Damper Pos, RF Status and Speed, DAT and setpoint, MAT, RAT, RA-RH, RA-CO2, OA Flow and setpoint, Filter DP.
- **AHU VAV w/ HRV**: SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, OA Damper Pos, Return Damper Pos, Defrost By-Pass Damper Pos, RF Status and Speed, DAT and setpoint, DA-RH, RAT, RA-RH, EAT, Humidifier Valve Pos, Filter DP.
- **VAV Boxes**: Flows Actual, Setpoint, Min, Max, Heat, Reheat Valve Position, Damper Position, Space Temp and Setpoint, Supply Temperature. Some have electric reheat coil. Some have radiation valve position.
- **MAU:** SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, OA Damper Pos, DAT and setpoint, Filter Status, Space Humidity and Setpoint
- **Boilers:** Boiler Status, HWST and setpoint, HWRT, Pump Status
- **CHW:** CHW Differential Pressure, DP Setpoint, Pump Status and Speed.
- **Chiller:** Chiller Status, Stage Status, Chiller Amps, CHWST and Setpoint, CHWRT
- **Floor plans:** VAV locations and Space Temperatures

College Services Building (6A)				State ID # E2615C1090	
Area (sq.ft)	36,626	Year Built	1990	Occupancy (hrs/yr)	4,992

HVAC Equipment

- **2 AHUs**

AHU-1	SF 50hp 38,900cfm, RF 25hp 34,600cfm	Serves 1st and part of 2nd floor.
AHU-2	SF 25hp 19,300cfm, RF 15hp 16,400cfm	Serves 3rd, part of 2nd floor, and part of Commons.

- **68 VAV Boxes, 35 of which are Fan Powered.**
- **Heating/Cooling**

Boilers	2,000 kBtu/h (2X)	Serving South Heating Loop.
Boiler	2,675 kBtu/h (1X)	Weil McClain Serving South Heating Loop.
HWP	20hp, 750gpm (2X) 15hp, 570gpm (2X)	South Heating Loop boilers are being commissioned in 2010.

Points on BAS

- **AHU VAV**: SF Status and Speed, DSP and setpoint, CLG Valve, HTG Valve, OA Damper Pos, Relief Damper Pos, RF Status and Speed, DAT and setpoint, MAT, RAT, SF Flow, RF Flow, Filter DP.
- **VAVs:** Damper Position, Flow: Current, Min, Max, and Setpoint, Reheat Valve Position, Space Temp and setpoint. Some are fan powered and as fan status.
- **Floor plans:** VAV locations and Space Temperatures

College Services Building (6B)				State ID # E2615C0996	
Area (sq.ft)	70,073	Year Built	1996	Occupancy	4,992

HVAC Equipment

- **3 AHUs**

AHU-1	SF 20hp 21,500cfm, RF 15hp 18,500cfm	Serves 1st floor.
AHU-2	SF 2hp 2,450cfm, RF 1.5hp 2,300cfm	Serves part of 2nd floor. Multizone
AHU-3	SF 20hp 24,800cfm, RF 10hp 22,000cfm	Serves 2nd and 3rd floor.

- **Heating/Cooling**

HWP 3&4	15hp, 150gpm	Has VFD, controlled to DP.
CHWP	7.5hp, 333gpm	Has VFD, controlled to DP.
Boilers (2 to be 4)	2X 5,055 kBtu/h	Boilers to be replaced with 4X 2,000 kBtu/h hi-eff boilers.

Points on BAS

- **AHU Multizone:** SF Status, RF Status, Chilled Water Valve, Hot Water Valve, CD and HD DAT and setpoints, MAT, RAT, Relief, and OA Damper position, Space Temperatures and setpoints.
- **Boilers:** Boiler Status, HWST and setpoint, HWRT, HW AHU DP, HW VAV DP, Pump Status and Speed, System Enable Setpoint
- **Floor plans:** VAV locations and Space Temperatures

Not Recommended for Investigation:

Five buildings totaling 40,605 square feet are not good candidates for investigation. Each of these buildings has a very small floor area, very limited if any HVAC equipment, and is not controlled by the building automation system. The College Center Building is being renovated at this time and is therefore not a good candidate. The screening information was collected from the site visit, interviews with facility staff, and the building automation systems.

Pole Barn North				**State ID #** E2615C0892	
Area (sq.ft)	3,200	Year Built	1992	Occupancy (hrs/yr)	N/A
HVAC Equipment					
• **No HVAC Equipment**					
Points on BAS					
• **No Points on BAS**					

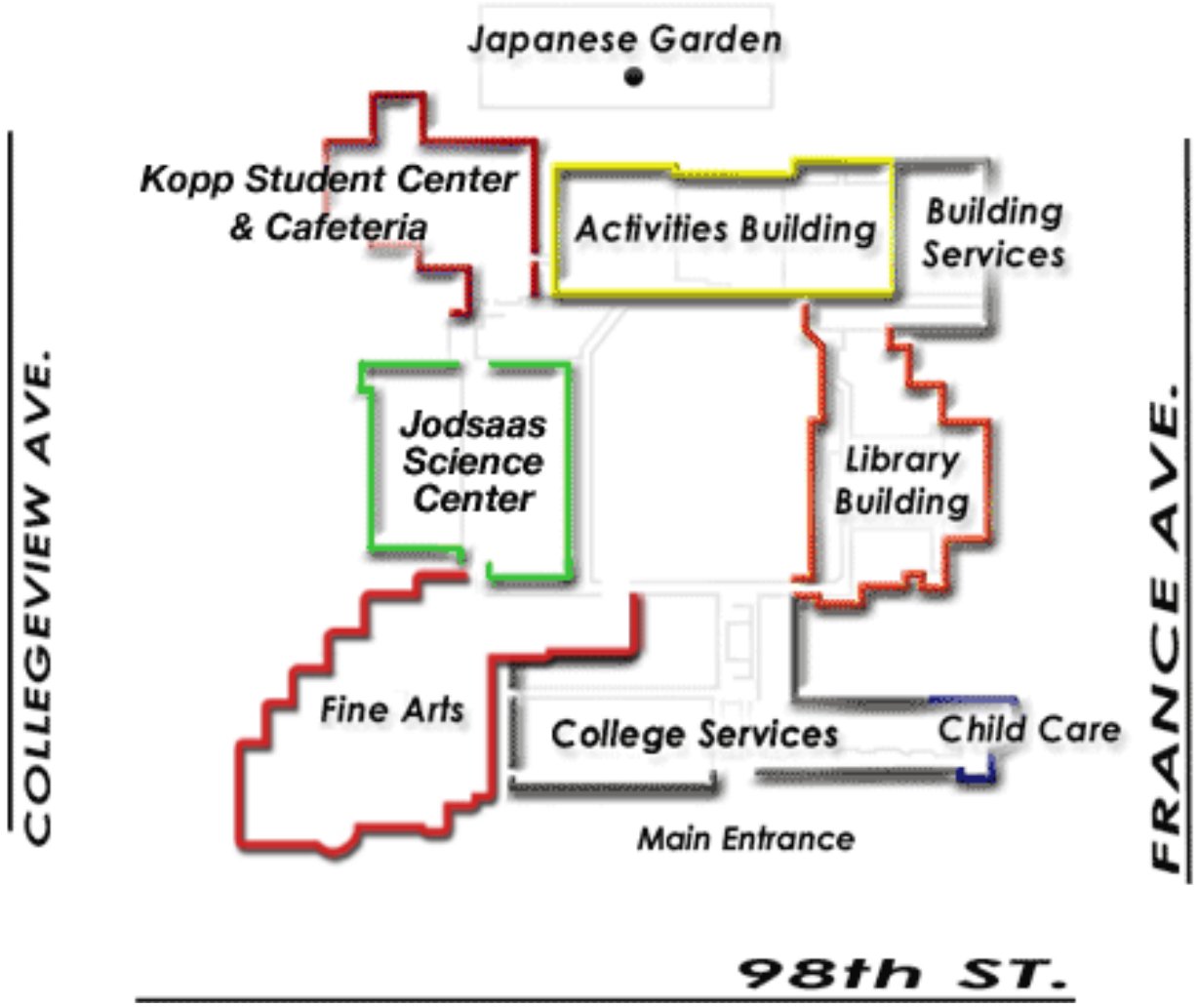
Bio Green House				**State ID #** E2615C1104	
Area (sq.ft)	1,221	Year Built	2004	Occupancy (hrs/yr)	N/A
HVAC Equipment					
• **No HVAC Equipment**					
Points on BAS					
• **No Points on BAS**					

Garage West Lot				**State ID #** E2615C1068	
Area (sq.ft)	3,200	Year Built	1992	Occupancy (hrs/yr)	N/A
HVAC Equipment					
• **No HVAC Equipment**					
Points on BAS					
• **No Points on BAS**					

Garage North Lot				**State ID #** E2615C0672	
Area (sq.ft)	3,200	Year Built	1992	Occupancy (hrs/yr)	N/A
HVAC Equipment					
• **No HVAC Equipment**					
Points on BAS					
• **No Points on BAS**					

College Center Building "Kopp Center"				**State ID #** E2615C0675	
Area (sq.ft)	33,734	Year Built	1975	Occupancy (hrs/yr)	4,992
HVAC Equipment					
• **All equipment is currently being replaced.**					
Points on BAS					
• **All equipment is currently being replaced.**					

Map of the Campus



Building Groups	Area (Square Feet)
Activities	45,357
Building Services	7,574
College Services	151,181
Fine Arts	60,591
Library	65,603
Science	105,199

PBEEEP Abbreviation Descriptions			
AHU	Air Handling Unit	HRU	Heat Recovery Unit
BAS	Building Automation System	HW	Hot Water
CD	Cold Deck	HWDP	Hot Water Differential Pressure
CDW	Condenser Water	HWP	Hot Water Pump
CDWRT	Condenser Water Return Temperature	HWRT	Hot Water Return Temperature
CDWST	Condenser Water Supply Temperature	HWST	Hot Water Supply Temperature
CFM	Cubic Feet per Minute	HX	Heat Exchanger
CHW	Chilled Water	kW	Kilowatt
CHWRT	Chilled Water Return Temperature	kWh	Kilowatt-hour
CHWDP	Chilled Water Differential Pressure	MA	Mixed Air
CHWP	Chilled Water Pump	MA Enth	Mixed Air Enthalpy
CHWST	Chilled Water Supply Temperature	MARH	Mixed Air Relative Humidity
CRAC	Computer Room Air Conditioner	MAT	Mixed Air Temperature
CUH	Cabinet Unit Heater	MAU	Make-up Air Unit
CV	Constant Volume	OA	Outside Air
DA	Discharge Air	OA Enth	Outside Air Enthalpy
DA Enth	Discharge Air Enthalpy	OARH	Outside Air Relative Humidity
DARH	Discharge Air Relative Humidity	OAT	Outside Air Temperature
DAT	Discharge Air Temperature	Occ	Occupied
DDC	Direct Digital Control	PTAC	Packaged Terminal Air Conditioner
DP	Differential Pressure	RA	Return Air
DSP	Duct Static Pressure	RA Enth	Return Air Enthalpy
DX	Direct Expansion	RARH	Return Air Relative Humidity
EA	Exhaust Air	RAT	Return Air Temperature
EAT	Exhaust Air Temperature	RF	Return Fan
Econ	Economizer	RH	Relative Humidity
EF	Exhaust Fan	RTU	Rooftop Unit
Enth	Enthalpy	SF	Supply Fan
ERU	Energy Recovery Unit	Unocc	Unoccupied
FCU	Fan Coil Unit	UH	Unit Heater
FPVAV	Fan Powered VAV	VAV	Variable Air Volume
FTR	Fin Tube Radiation	VFD	Variable Frequency Drive
GPM	Gallons per Minute	VIGV	Variable Inlet Guide Vanes
HD	Hot Deck	VUH	Vertical Unit Heater
HP	Horsepower		

Conversions:
1 kWh = 3.412 kBtu
1 Therm = 100 kBtu
1 kBtu/hr = 1 MBH